Light and Lighting

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Edited by J. STEWART DOW

Telephone: ABBey 5215

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Bright Light Sources

MR. Aldington's interesting paper before the I.E.S. (See p. 173) is a reminder that in the lighting of the future we should not put all our eggs into one basket.

In spite of the higher efficiency of other sources it seems likely that whenever concentrated beams of light are needed the work will continue to be done by filament lamps, at least for some years to come.

It is also opportune in reminding us that there are still many fields where high brightness is no drawback, but on the contrary is the chief consideration. This applies where optical projection is involved, for the cinema and the lantern, and for signalling devices.

But it also applies very largely wherever controlled direction of light is aimed at, *e.g.*, for spotlighting, floodlighting, spectacular effects and for industrial processes where exceptionally high intensities or directional effects are desired.

We are not likely to forget the inherent advantages of natural light from the white sky or artificial light from fluorescent lamps—low brightness, colour and good diffusion. They are very great. But natural light, like the wind, goeth where it listeth. Sometimes we wish to direct the flow.

New I.E.S. Groups

The formation of two new I.E.S. Groups in Liverpool and Edinburgh is now being arranged. It is certainly an anomaly that there has hitherto been no I.E.S. organisation in these two important cities and it may well be expected, now that a start has been made, that they will attain to Centre status before very long. The movement in Liverpool is largely due to the enthusiasm of Mr. Alan Owen, the honorary secretary of the Manchester Centre. Mr. M. W. Hime, the honorary secretary of the Glasgow Centre, has been similarly active in connection with the formation of a group in Edinburgh, where a meeting was held in the Heriot-Watt College on October 27. Mr. W. J. Jones (Past President) delivered an address to the members and visitors present in which he reviewed the past history of the Society and mentioned the names of some of its distinguished past presidents who, like himself, have helped to bring the Society to its present stage. Professor Say was responsible for the vote of thanks to Mr. Jones. Subsequently those present elected an organising committee with Mr. N. G. Wilson as chairman, and Mr. S. G. Batt as hon. secretary. We wish all success to both ventures.

The Gloucester and Cheltenham Group, the initiation of which we noted some months ago (July, 1944, p. 98) is now firmly established. At its recent inaugural meeting Mr. Howard Long—who had so much to do with the creation of the Birmingham and Nottingham Centres—gave an introductory address in which he reviewed the activities of the Society since its formation in 1909, its wide scope and the invitation it offered to all interested in lighting to join its ranks.

The Group is fortunate in having secured the co-operation of local supply undertakings. Mr. W. A. Chard (Gloucester Gaslight Co.) proposed the vote of thanks to Mr. Long and Mr. W. R. Steel, Chief Electrical Engineer to the Cheltenham Corporation, seconded it. A representative committee has already been formed with Mr. A. L. Morris, of the Cheltenham and District Gas Co., as chairman, Mr. I. S. Freemantle as secretary, and Mr. E. G. Purnet as treasurer. It is planned to arrange regular meetings, to take place on the third Thursday in each month, alternately in Gloucester and Cheltenham.

American I.E.S.: New Executive Secretary

It will be recalled that we recently mentioned the retirement of Mr. F. G. Horton, who had served as executive secretary of the American I.E.S. for 20 years. We now hear that his place has been filled by the election of Mr. A. D. Hinckley, who has an intimate knowledge, extending over many years, of the Society's activities, having served on numerous committees in addition to his having filled the offices of General Secretary and Director of the Society.

Forthcoming I.E.S. Meetings

SESSIONAL MEETINGS IN LONDON

1944.

Dec. 12th. DR. J. H. NELSON on **Motor Car Headlights.** *(Sessional Meeting to be held at the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.)* **5.30 p.m.**

To be preceded by an **Extraordinary General Meeting** at which a Poll will be taken on the Proposals for an **Increase in Subscriptions. 4.30 p.m.**

Dec. 27th, 28th and 29th. "The Wonders of Lighting." *(Christmas Lectures to Children.)*

MEETINGS OF CENTRES AND GROUPS

1944.

Dec. 1st. MR. F. E. BUCKELL on **Electricity for Aircraft.** *(At Radiant House, Bath.)* **7 p.m.**

Dec. 1st. MR. L. G. APPLEBEE on **The Design and Lighting of a Civic Theatre.** *(At the Crescent Theatre, Birmingham.)* **6 p.m.**

Dec. 1st. P. J. BARTLETT, T. C. HOWITT and A. J. THRAVES on **Lighting: the Architect's Point of View.** *(In the Lecture Theatre of the City of Nottingham Gas Department, Parliament Street, Nottingham.)* **5.30 p.m.**

Dec. 4th. MR. J. S. PRESTON on **Photometry.** *(At Nether Chapel, Norfolk Street, Sheffield.)* **6 p.m.**

Dec. 5th. R. GILLESPIE WILLIAMS on **The Poetry of Light.** *(In the Electricity Showrooms, Market Street, Huddersfield.)* **7 p.m.**

Dec. 5th. MR. P. HARTILL on **Illumination and Illusion.** *(At the Leicester Corporation's Electricity Department Demonstration Theatre, Charles Street, Leicester.)* **6 p.m.**

Dec. 5th. MR. T. S. JONES on **Special Industrial Lighting Problems.** *(In the Borough of Derby Electricity Showrooms, Irongate, Derby.)*

Dec. 6th. MR. M. W. HIME on **The Trend of Discharge Lamp Development.** *(In the Minor Hall, Oxford Street, Newcastle-on-Tyne.)* **5.30 p.m.**

Dec. 7th. Address by THE PRESIDENT. *(At the Guildhall, Swansea.)* **3.30 p.m.**

Dec. 7th. MR. R. GILLESPIE WILLIAMS on **The Poetry of Light.** *(Meeting of the Leeds Centre, meeting place to be announced.)* **6 p.m.**

Dec. 8th. MR. F. L. CATOR on **Lighting in the Engineering Industry.** *(In the Bradford Electricity Department Showrooms, Sunbridge Road, Bradford.)* **6.45 p.m.**

Dec. 13th. MR. F. E. ROWLANDS on **Infra Red.** *(At "The Cadoro," Glasgow.)* **6 p.m.**

Dec. 14th. MR. J. N. ALDINGTON on **Bright Light Sources.** *(In the Reynolds Hall, College of Technology, Sackville Street, Manchester.)* **2.30 p.m.**

Dec. 15th. DR. C. BERNARD CHILDS on **"Light and Colour."** *(In the Edinburgh University Physics Department, Drummond Street, Edinburgh.)* **7.15 p.m.**

Dec. 21st. MR. E. G. PERNET on **Illumination Display Advertising.** *(At Fearis' Café, Southgate Street, Gloucester.)* **7.15 p.m.**

Dec. 27th and 28th. Christmas Lecture to Children. *(In preparation by Leeds Centre.)*

Dec. 28th and 29th. Christmas Lectures for Children. *(In preparation by Bradford Group.)*

I.E.S. Transactions

No issue of the *I.E.S. Transactions* is being made during the month of November. The next copy will be circulated with the December issue of *Light and Lighting.*

(Secretaries of Centres and Groups are requested to send in particulars of any changes in programmes, mentioning subject, author, place, date and time of meeting; summaries of proceedings at meetings (which should not exceed about 250-500 words) and any other local news are also welcome.)

Lighting of Class "A" Roads

An entertaining feature arranged by the I.E.S. Birmingham Centre, on November 3, was a debate on the proposition "that the lighting of Class 'A' roads by stationary lights is necessary." The proposers were Mr. F. L. Cator and Mr. F. F. Middleton, and the opposers Dr. J. H. Nelson and Mr. C. F. Partridge. The audience (of about 60) were warned by the chairman that their decision should be guided solely by the evidence submitted. Both proposers and opposers stated their views well, and a very interesting discussion ensued—with the result that a 50-50 vote was finally taken. This proved to be a most enjoyable meeting, at which the Birmingham members had the pleasure of welcoming Mr. R. O. Ackerley (past president).

The Trend of Domestic Lighting

An enterprising departure by the Cardiff Centre on November 2 was a meeting devoted to a discussion on the above subject, specially arranged to bring together members of the I.E.S., the Electrical Association for Women, the Women's Guild of Domestic Arts, and similar bodies. The meeting took place in the Corporation Demonstration Theatre in Cardiff and was well attended, about 60 ladies being present. Mr. S. G. Turner, the hon. secretary of the Centre, opened the discussion, in the course of which many interesting questions (some submitted by invitation prior to the meeting) were dealt with by a panel specially appointed for the purpose and consisting of Mr. D. C. James, Mr. W. G. Chilvers, Mr. T. Scott Harrison, and Mr. Turner himself. Requests to hold similar meetings early in 1945, when even larger audiences are expected, have since been received.

School Lighting

A talk on this subject was given by Mr. T. S. Jones to the I.E.S. Huddersfield Group on November 7, when Mr. E. Lunn (vice-chairman) presided. In his address Mr. Jones stressed the importance of reinforcing good lighting by decorations in light colours with non-reflecting surfaces. Artists' impressions in water-colour had shown how even old school buildings could be brightened in this way; new lighting units designed to give even and diffused light could be installed at quite moderate expense. The new Education Act, by encouraging evening classes, would accentuate the need for good artificial lighting, in which fluorescent tubes might play an important part. The education architect, Mr. G. Crossley, had accepted the group's invitation to attend. In contributing to the discussion he expressed agreement with most of what the lecturer had said, and he warmly welcomed the suggestion that architects and lighting experts should co-operate in this field. After Mr. Jones had replied to the discussion, in which several members took part, a cordial vote of thanks to the lecturer was proposed by Mr. H. L. Walker, seconded by Mr. J. T. Thornton, and carried unanimously.

Street Lighting and Crime

Although many efforts have been made to demonstrate the value of good street lighting in minimising traffic accidents little information of its advantages in another respect—the reduction of crime—is available. It is therefore of interest to note the issue in America of a folder giving data in support of this belief. In one Californian city it was observed that 4,500 felonies took place in one year between 8 and 10 p.m., as against 850 from 8 to 10 a.m. Another instance is that of a Wisconsin city which decided to save 3,200 dollars annually by turning off street lamps at 11 p.m.—the result being 20 homes robbed the first night.

Bright Light Sources

Summary of a paper read by Mr. J. N. Aldington at the Sessional Meeting of the Illuminating Engineering Society on November 14th.

There was an excellent audience at the last I.E.S. Sessional Meeting at the Lighting Service Bureau on November 14, when Mr. J. N. Aldington's paper on the above subject was read. The address was illustrated by effective demonstrations and gave rise to a good discussion. In his introductory remarks he reminded his hearers that for the purpose under consideration filament lamps have still an important role to play.

Two main classes of electric lamps designed specifically for projection purposes may be considered under the title "Bright Light Sources." At the present time, and in all probability for many years to come, the most important class is that of the incandescent tungsten filament projector lamps. The other class, comprising high-brightness electric discharge lamps, has perhaps received greater publicity of recent years owing to some comparatively recent development in this field. The paper reviewed the state of the art in respect to tungsten filament projector lamps and discussed some of the more notable advances.

Developments in the field of incandescent electric lamps have resulted both from improvements in the stability of tungsten filaments and from design features directed towards a more effective utilisation of the emitted flux. Over a period of years a number of principal types of projector lamps have evolved, of which the most important are:—

(a) Straight, single coil lamps; (b) Flat grid projector lamps; (c) Multiplanar projector lamps; (d) Coiled coil filament lamps; (e) Uniform sources; (f) Multi-filament lamps.

Dealing with the subject of tungsten filament lamps in general, the author paid some consideration to the properties of straight tungsten filaments, both in vacuo and in gas. The effect of electrode and cooling was discussed, and the change in characteristics which results from the introduction of an inert gas illustrated by efficiency and brightness measurements.

The chief representatives of class (a) are the exciter lamps, in which a short, single tungsten helix operates from a comparatively low voltage at a brightness of the order of 2,000 candles per sq. cm. Another example is the horizon lamp in which a straight filament coil 200 mm. long, containing two metres of wire, is sufficiently stable to exhibit little sag throughout a life of 200 hours.

Particulars of flat grid projector lamps were next given, and a comparison was made between the average brightness of this type of filament and the biplane arrangement, which shows that the latter type may have an average brightness of the order of twice that of the former. In discussing a range of coiled coil filament projector lamps, Mr. Aldington illustrated the effect of double coiling and of means for reducing the interfering effects of tungsten evaporation. The class of symmetrical sources as distinct from directional light sources was described by reference to bunch filament lamps, lamps with a cruciform filament arrangement and one or two special types, but no attempt was made at an exhaustive survey of all the possibilities which have been examined.

The principles underlying the development of the multi-filament lamp were described in some detail. Comparative figures are given for a range of multi-filament lamps and coiled coil lamps, and it was shown that by utilising the so-called "solid source" principle a marked increase in the directional properties of low-voltage projector lamps can be achieved. The reasons for this result were analysed, and the effect of the decreased thermal losses and increased average brightness illustrated graphically. Some particulars were

given of special types of projector lamp operating in a series of modern projector lanterns and utilising internal reflectors.

As usual with Mr. Aldington's addresses the demonstrations proved particularly interesting. Members were all impressed by the slick manner in which filaments, projected by the lantern, were caused to move into position so as to form a uniform bright area, such effects as the intensification of brightness at the edges of adjacent coils being clearly shown. In the course of his address Mr. Aldington mentioned that he hoped later on to have an opportunity of giving a supplementary paper showing the possibilities of other bright light sources, such as those based on the use of super high-pressure mercury lamps.

I.E.S. Subscriptions

Previous to the sessional meeting recorded above, when Mr. Aldington's paper was read, there was an extraordinary general meeting to consider the proposals for increased subscriptions. The chief alterations proposed relate to Fellows, Corporate Members and Associates, whose subscriptions will be £3 10s., £2 10s., and £1 10s. per annum (instead of £2 12s. 6d., £2, 2s. and £1 1s.) respectively, if the proposals are adopted.

After the hon. secretary had read the notice convening the meeting, which contained the formal resolution specifying the changes proposed, the President (Mr. E. Stroud) briefly recalled the circumstances which had led to this step. He emphasised the need for increased revenue in order to provide for a permanent secretary, increased staff, and (ultimately) better office accommodation —as well as to provide for the various new activities indicated in the circular notice issued to all members.

He then formally presented the resolution which was seconded by Mr. R. O. Ackerley. From the ensuing discussion it seemed evident—as the many letters received by the President had also suggested—that members as a whole accepted the necessity for increased revenue. There were, however, some who hoped that this might be gained by a progressive increase in membership. Against this it was argued that the increased revenue was needed *now* and that the surplus of income over expenditure revealed during recent years was due mainly to the fact that, under war conditions, the Society could not spend on developments what it would normally wish to do. (The present meagre size of the Transactions, resulting from the paper restrictions, was mentioned as a typical instance.)

When a vote by show of hands was taken there was a large majority for the resolution. It was stated, however, a poll had been demanded, on the ground that relatively few members were able to travel to London to attend the present meeting.

The President, in accepting the demand, recognised the desirability that distant members should have an opportunity of recording their votes, and it was agreed that the poll should be taken at 4.30 p.m. on December 12, prior to the next sessional meeting at the Lighting Service Bureau (2, Savoy Hill, London, W.C.); and that in the meantime proxy forms would be circulated to all members qualified to vote.

The Black-Out

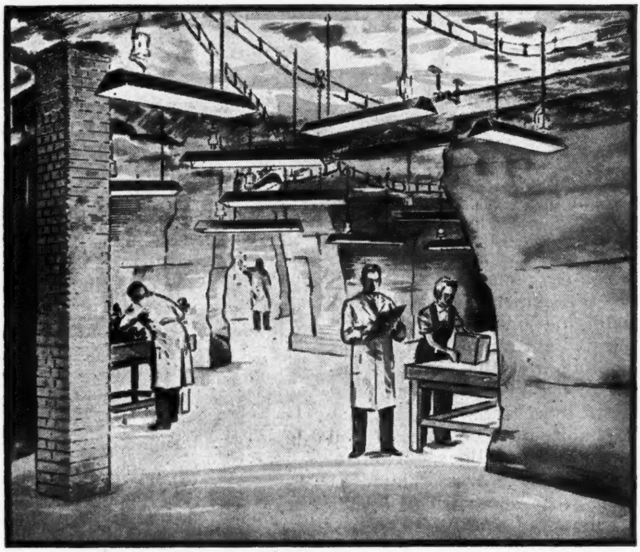
The lapse of time since the announcement of the alleviation of the black-out, in September last, permits a survey of the benefits gained. Areas where alerts are unlikely and where central control of the street lighting is possible have benefited most. For evident reasons, however, Londoners have not gained much. It is only during the present month that permission to make full use of the concessions in London has been granted. The peculiar administration of London's public lighting, shared by so many independent authorities, also renders uniform action most difficult. Some authorities seem to be installing a relatively high but sometimes patchy illumination, which presumably has to be extinguished in the event of an alert. Others are adopting the "moonlight" schedule (0.02 ft.c.), which can usually be obtained by fairly easy modifications where wartime street lighting (0.0002 ft.c.) is already in use. Although the actual value may seem low the hundredfold improvement is physiologically a very substantial one—with the great advantage that it can be kept on permanently, even during alert periods. In cases where any general improvement in public lighting is considered too difficult the authorities might well encourage the installation of a more generous amount of illumination from a few well-screened units at selected important points. This is one of the ameliorations suggested by the I.E.S. early in 1941*. The public has likewise been slow to take advantage of the permission to adopt lighter curtains—again, for obvious reasons. Apart from the expense and difficulty of getting new material there remains the awkward obligation to reinstall the complete black-out whenever an alert happens to be sounded. If the authorities have in mind any further concessions at Christmas they might do worse than relax the restrictions on shop-window lighting, which contribute so greatly to the dismal nature of city streets during the dark winter period.

* War Time Street Lighting and Aids to Movements in Streets. (Trans. Illumin. Eng. Soc., London, February, 1941.)

"Sling-Shot Sabotage"

The misfortunes which lamps and lanterns suffer in our streets are—goodness knows—many, even in normal times. During war conditions, in addition to damage caused by enemy action, there have been instances of misguided citizens throwing stones at "0.0002 foot-candle" street lighting units, believing even these mild luminaries to be a source of danger. We do not, however, seem to have suffered greatly from the "sling-shot sabotage" reported in the U.S.A.—for example, in Sioux City, where 1,091 street lamp bulbs were broken in the residential sections by mischievous boys and girls with "sling-shots, BB guns, etc." To cure this evil 46 lectures and demonstrations in the schools were arranged. *Illuminating Engineering* reproduces a picture of Mr. C. R. Tracy giving a talk on this subject and holding up a fitting which has evidently been well peppered.

RESEARCH BEHIND LIGHTING



DAYLIGHT-*Underground!*

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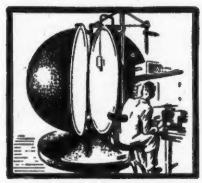

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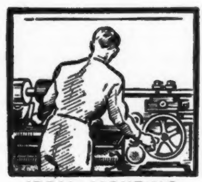
This remarkable achievement in lighting technique is due in large measure to the data provided by a range of delicate scientific instruments used in the BTH Research Laboratories.

The Integrating Photometer — here illustrated — is just one of these valuable "assistants" constantly working for the BTH Lighting Engineers.



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Illumination and Illusion

This title of the address given to the I.E.S. Huddersfield Group on October 3 by Mr. P. Hartill might be regarded as the converse of that adopted some years ago by Mr. R. O. Ackerley (" Seeing is believing ")—though a closer study would show that they are not inconsistent.

In his opening remarks Mr. Hartill emphasised the importance of illuminating enginering—modern civilisation needs artificial light almost as much as food or clothing—yet the continual influx of new modes of lighting and new ideas has in this case rather accentuated the habitual reluctance of the public towards innovations. Galileo, Stephenson and others were quoted as instances of great men whose ideas, when first announced, met little support. In the lighting field the public is apt to be confused by new devices and new dogmas, not to mention the " immense wave of propaganda . . . clever but bogus visual tests . . . doubtful statistics and pseudo-scientific conclusions . . ." mentioned by Dr. Parry Moon as factors in the situation.

It is, therefore, necessary to take a realistic view of light, vision and illusion. Without vision there can be no light—and without light there can be no vision. Mr. Hartill, whilst recognising the value of photometric measurements, stressed the need for interpreting them in relation to *effects* of light. Probably no two people have the same light-sensitivity, and this quality, even in one and the same person, varies from hour to hour. We should therefore regard the " candle " as a unit of radiant energy rather than a unit of *light*. It was not until 1924 that international agreement was even reached on a standard of " normal vision " and the standard visual sensation curve was derived.

This led the author to enter into an analysis of sensations of brightness and colour and their influence on visibility—a term which scientists have had great difficulty in defining—and on the ability of the eye to identify and distinguish surrounding objects. In this connection the distribution of light is all important. It is a notable fact that the lowest percentage of cases of defective vision is found amongst outdoor labourers. Yet the importance of light to the health of industrial workers is insufficiently realised. Many people still consider that it is only the light on the job that matters. One hears the view expressed that light expended on the walls and ceiling is light wasted. Another illusion is the prevalent belief that dark surroundings serve " to rest the eyes "—whereas the continual readjustment as the eyes turn from brightness to obscurity is fatiguing. On the other hand the brightness of the background must not be excessive, or the task will appear underlighted.

This problem has a bearing on the technique of cinema theatres. It was formerly considered that the best visibility of the screen would be obtained by making the surrounding area as dark as possible, whereas the modern tendency is to furnish illumination of the surroundings to a brightness approaching that of the picture itself. This has been found to result in much more comfortable seeing conditions.

In the concluding portion of his address, Mr. Hartill discussed the limitation of glare and quoted rules framed to minimise it. He pointed out particularly the element of " distraction " when bright images are received on the retina, and stigmatised as yet another illusion the habit, which not infrequently enters into the apprisement of street lighting systems, of judging the installation by the apparent brightness of the sources installed. The psychological factor is important. A man may believe that he sees better in certain circumstances, in defiance of scientific tests. Besides the after images caused by undue brightness, of which we are made painfully aware in the black-out, there is often a species of mental persistance, the " set " of the mind which clouds the judgment.

Electrical Accidents and Their Causes

The report presented by the Factory Department (Electrical Branch) for 1943, whilst not containing much that bears specifically on lighting, is of considerable general interest. The total number of fatal accidents, after rising progressively for the preceding four years, drops in 1943 (from 181 to 165). A welcome item is the decrease in mishaps to male workers under 21 years, who seem now to be "leaving well alone," thus imitating their lady colleagues, who rarely sustain damage from electricity. Reference is made to the increasing use of flame-proof apparatus. An effort to develop a lightweight flameproof handlamp is now being made. Evidently portable apparatus needs special care, for nearly one-third of the fatal accidents were associated with their use. Electric welding plant is another source of trouble. Nearly 35 per cent. of the total accidents (fatal and non-fatal) were thus caused, the trouble in most cases being the familiar "eye-flash," which can be reduced by wearing plain glass spectacles or by more careful methods of screening.

" Brightness "

The importance of " brightness " in the modern conception of illuminating engineering is continually being emphasised and discussed. Background brightness is now a familiar consideration in the design of industrial and other lighting installations, and such expressions as " brightness ratio " and " brightness difference " (which may or may not be entangled in the conception of " contrast ") play an important role in deciding the illumination requisite for the performance of any particular task.

The study of brightness is, however, beset by difficulties. Not only is brightness not very easy to measure—so far as the man-in-the-street is concerned—but the variety of units and the odd terms given to some of them (how often one has been asked the meaning of " stilb " and " apostilb ") cause perplexity. Further, there is always the uneasy feeling that although one is quoting a physical quantity (e.g., candles per sq. in.) one is thinking of a visual effect. It was, perhaps, this consideration that led Dr. W. D. Wright to plump for a new subjective unit based on sensation, the " brill."

These various factors are reviewed in a contribution to *Illuminating Engineering* (September, 1944) by Parry Moon and Domina E. Spencer, in which three main sources of trouble are recognised: (1) confusion arising from numerous meanings of brightness; (2) unsatisfactory definitions of the concept of brightness; and (3) needless complication in brightness units. Of the term " brightness " the authors remark that it has the attractive characteristic that everyone knows what it means. The artist, the psychologist, and the man-in-the-street each knows what it means—but each such meaning, vague and nebulous though it is, is different from the others.

The authors, therefore, determine to abandon the term altogether and to introduce the concept of *helios*, a word of Greek origin, to denote brightness in a purely physical sense. It is also pointed out that confusion has been caused by including the idea of a perfectly diffusing surface and that no consideration is given to volume sources, whilst the medley of existing terms (stilb, candle /mm^2. candle/m^2, candle/ft.^{2}, etc.) is a nightmare. (Fortunately, the authors remark, we have so far been spared candle/acre, yardlambert, and inchlambert.)

The helios H at any point P and in a given direction is defined as π times the luminous flux density in that direction per unit solid angle, and is expressed by what may, perhaps, be considered a rather formidable looking term, namely:—

$$H = \pi \lim_{\omega \to 0} (D/\omega)$$

The unit of *helios* is π times the lumen per square metre per steradian, and is to be termed the " blondel." A table is presented showing its relation to all other units of brightness, including those mentioned above. It is numerically equal to the apostilb and the equivalent metre-candle, and is 1-10th of the millilambert.

The subject is also studied in a contribution by Harris Reinhardt in the same issue of Illuminating Engineering. He, too, draws attention to the variety of units in use and presents a table facilitating conversion from one to the other. The author is largely concerned with the two alternative methods of expressing brightness, e.g., in such terms as " candles per square inch " or " equivalent foot-candles," and he quotes, in an appendix, the views of Dr. J. W. T. Walsh and Mr. A. S. McAllister, which are apparently at variance on this point. On the whole he is of the opinion that both methods have their advantages, as is illustrated in practice by the use of candles per unit area for sources of light and lumens per unit area when dealing with reflecting surfaces. It is, however, important to bear in mind the consequences of a considerable departure from the " ideal diffusing surface."

The Colours of Black Bodies

In the study of radiation a "black body" is a body which emits radiation according to certain well-known and rigidly defined laws. Nowadays it is more often referred to as a "total radiator," and, in fact, the term "black body" is rather an unhappy one. It arises from the fact that if a body absorbs completely all the radiation that falls on it, then when it is heated to a certain temperature (T say) it gives out radiation which has a certain spectral distribution defined solely by T, and not at all by the particular construction of the body. Of course a body which absorbs all the incident radiation appears perfectly black, but actually it is not the absorbing properties but the radiating properties of the body that are of interest in pyrometry, colorimetry, and photometry, and so "total radiator" seems a more appropriate name. That was the name used by Mr. H. G. W. Harding in his paper read before the meeting of the Colour Group held on September 20 at the E.L.M.A. Lighting Service Bureau.

The full title of the paper was "Illuminants for Colorimetry and the Colours of Total Radiators," and in it Mr. Harding first reviewed the history and described the properties of the standard illuminants A, B, and C, recommended for colorimetry by the International Commission on Illumination in 1931. These are now widely used, and are generally referred to as the C.I.E. standard illuminants. Other illuminants, such as the equal-energy illuminant (wave-length basis) and some employed for special purposes in the U.S.A. were also described.

For colorimetric purposes the trichromatic coefficients of the colours of total radiators are often required, and tables have been prepared at the National Physical Laboratory giving these coefficients for all temperatures from 1,500-9,000 deg. K at intervals of 10 deg.

It is a fortunate fact that a tungsten filament lamp radiates very nearly as if it were a total radiator, within the limits of the visible spectrum. It is therefore possible to describe the colour of the light from such a lamp very conveniently and concisely by means of the temperature of a total radiator which gives radiation having the same spectral distribution, again within the limits of the visible spectrum. This temperature is termed the "colour temperature" of the lamp. For the ordinary gas-filled lamp, for example, the colour temperature at rated voltage is not far from 2,800 deg. K.

Mr. Harding, in his paper, discussed the difficult problem of trying to assign a "colour temperature" to a lamp when the spectral distribution of the light is *not* very closely the same as that of a total radiator at *any* temperature. Strictly speaking, of course, such a lamp has no colour temperature at all, but the convenience of the system is such that an attempt has to be made to assign one to it, albeit only approximately, and the method by which this is done was described in some detail.

At high values of colour temperature it is, of course, impossible to use as standards tungsten lamps actually running at these temperatures, and therefore colour filters have to be used to change the spectral distribution of the light from a lamp running at a moderate colour temperature (say 2,400 deg. K), so that the transmitted light has the desired spectral distribution. The scale of colour temperature above 2,400 deg. K has been established in this way at the National Physical Laboratory, and in the concluding section of his paper Mr. Harding describes this.

In the discussion which followed the paper, Dr. W. D. Wright advocated the more general use of the equi-energy standard often referred to as standard illuminant E. The fact that it was impossible to assign a colour temperature to lamps of the discharge-tube type was mentioned by Mr. G. T. Winch.

Fluorescent Lighting on the Racecourse

At first sight a racecourse would seem to be about the last place where fluorescent lighting would be adopted. It is, however, being used in New Hampshire (U.S.A.)—not for the illumination of the track but in the clubhouse, grandstand, and tellers' booths.

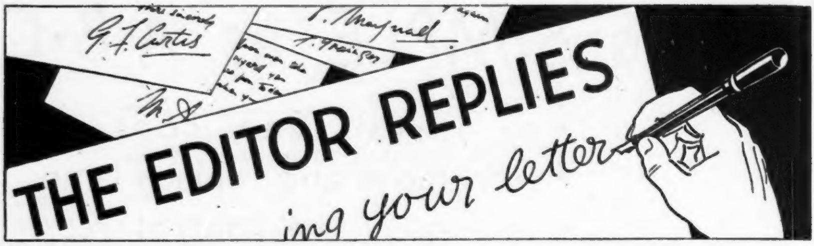
The last named is the most interesting of these applications. In ILLUMINATING ENGINEERING (Sept. 1944) the arrangement of these tubes over the booths, where tickets are examined, is illustrated. The tubes are mounted 4 ft. above the desks and are fitted with shields to protect the eyes of the tellers from possible glare.

An interesting feature is the installation of ultra-violet ("black light") lamps between alternate paying tellers' booths, in order to prevent fraud in the presentation of winning tickets, which are now marked with secret symbols which fluoresce under the ultra-violet radiation.

At one time cold winter winds necessitated the wrapping of tubes in transparent cellophane to insure satisfactory operation, but the use of low temperature lamps now renders this unnecessary.

Improved Lighting in a Lancashire Textile Mill

The adjacent illustration is a view of the doubling room in a large Lancashire mill. The lighting installation in this room consists of 89 Mazda 150-watt lamps in low temperature type dispersive reflectors. The mounting height is 9 ft. 6 in., and units are spaced 10 ft. apart, giving an illumination of 8-10 ft.c.



I have had some discussion in regard to the installation of **better lighting in the streets**—a tough problem in present circumstances. Some suitable fittings furnishing 0.02 and 0.2 ft.c. were mentioned in our last issue (p. 166). I may also recall the specifications, BS/ARP 16, 20, and 21, issued shortly after the outbreak of war.

It is only fair to point out that these specifications were produced in emergency, and could doubtless be improved upon as a result of subsequent experience. The war-time street-lighting units have proved their value and done a good job, but I do not feel so happy about BS/ARP 20, which was designed to furnish an even illumination of 0.02 ft.c., derived from a 100-watt pearl lamp, with a spacing of not less than five times the mounting height. This condition can hardly be fulfilled without a **substantial amount of glare.** In this respect the subsequent specification, BS/ARP 21, furnishing 0.2 ft.c. but assuming much closer spacing, is a preferable design.

This question of modified public lighting is dealt with elsewhere in this issue (see p. 176). If the idea there envisaged is presented—that at the moment it is better to concentrate on **improved lighting at selected busy or dangerous spots** rather than to attempt general lighting —there is no difficulty in providing a relatively deep reflector, masking the source in all ordinary directions of view and reducing glare to a minimum.

Mr. Hime has returned to the charge with some further comments on demonstration of **the inverse square law,** which, he suggests, should be carried out with what are approximately "point" sources. Extending the treatment to a source in the form of a circular disc, he quotes the formula:—

$$F=\frac{LR^2}{D^2}\left[1-\left(\frac{R}{D}\right)^2+\left(\frac{R}{D}\right)^4-\left(\frac{R}{D}\right)^6+\ldots\ldots\right.$$

where E is the illumination in foot-candles, L the candle-power, R the radius of the disc, and D the distance. If an error of 1 per cent. is permissible, the second term is to be 0.01; then

$$R/D\ \sqrt{0.01}=0.10,$$

which implies that the inverse square law will hold within 1 per cent. if the distance is at least 10 times the radius of the circular source.

In modern lighting installations, however, such conditions rarely apply. The formula $E = L\ (R^2/R^2 + D^2)$ shows us that when D becomes negligible in comparison with R the illumination is constant for all values of the distance. This condition is quite frequently approached when we are dealing with an illuminated ceiling or even a mass of closely spaced lighting units overhead—in fact with most fluorescent tube installations there is a wide range of heights contiguous to the working plane at which **the level of illumination is practically constant,** and this illumination would scarcely be affected if the height of the fittings is increased by a foot or two.

In the past the inverse square law, taught as a fundamental fact in all courses, has sometimes proved a source

of confusion when applied by those with a little learning to practical lighting installations. It is likely to prove even less applicable to the lighting of the future. Perhaps, therefore, the time has come when it might be put out of sight in the cupboard—at least so far as the laymen are concerned.

Mr. P. J. Waldram, in sending me copies of several of his recent useful contributions to *The Builder*, raises one very pertinent inquiry which framers of future ordinances and regulations would do well to ponder, **"What is adequate daylight?"** He contends that, whereas there has been a considerable amount of practical research on the narrow range of daylight just adequate for ordinary purposes (e.g. to meet the demand created by ancient light cases), we really know very little about the upper ranges, such as the higher daylight factors required in industry.

In this connection, he contends, we need further research into the reactions of the eye and psychological effects. This is a field where most of us are conscious of some degree of uncertainty. If we accept the conclusions implied in the work of Weston and others that the requisite artificial illumination, for a certain standard of performance, can be assessed once such factors as the size of object, reflection factor, contrast, etc., are known, can we apply this knowledge to daylight? Are we right in assuming that the illuminations specified in the **I.E.S. Code** apply alike to **natural and artificial lighting,** and in calculating back from them to judge the requisite daylight factors?

On this point there seem to be two schools of thought. I believe that many architects feel instinctively that natural lighting and artificial lighting are not the same, and that conclusions formed in regard to one do not apply to the other. On the other hand lighting engineers, after their first nervous inspection of daylight problems seem to be rallying to the belief that a certain illumination on the working plane for a specific task can be prescribed—whether it comes from natural or artificial lighting or a mixture of both.

This view is based on the consideration that the illumination necessary for any particular task or process depends primarily on the appearance of the (usually relatively small) area of work. It may be also affected to some extent by surroundings and background; but quite big variations in these conditions occur in artificial light as well as in daylight.

There is, however, another important point; the importance of **quality of daylight illumination,** which has scarcely been considered in existing codes based on daylight factors. If the quality of artificial lighting is often unsatisfactory, natural interior lighting is far from faultless. Apart from the enormous variations in illumination that are found as one recedes from a window, this window, if inconveniently placed, is often a powerful source of glare, as anyone trying to distinguish the features of a chairman of committee with his back to the light will quickly discover.

The interest now taken in the **colouration of objects in workshops, etc.,** with a view to creating desirable contrast and pleasant impressions, is leading American experts to scrutinise more closely the definitions involved. It is an anomaly that whilst everyone admits the importance of colours, there is little guidance available as to their choice and combination. In this connection Dr. J. H. Nelson has drawn my attention to some recent papers by Mr. Parry Moon, who distinguishes quantitatively the following factors:—(1) Identity; (2) First ambiguity; (3) Similarity; (4) Second am-

biguity; (5) Contrast; and (6) Glare. Of these (1), (3), and (5) form pleasing relations between colours, whilst (2), (4), and (6) give rise to displeasing ones.

I have been asked whether the **fluorescent tube** can be satisfactorily tested in **an integrating sphere photometer.** I should say that this is very much the most convenient way of testing the total lumen output of such a source, which would be laborious to ascertain by " point to point " methods. Even if only the candlepower in a direction perpendicular to the axis of the lamp is desired one has to be careful that the testing distance is sufficient.

An obvious requirement, however, is that the sphere must be big enough to get the lamp in! Even the presence of this relatively large foreign body must involve some error. I am not prepared to say off-hand how large the sphere must be before such errors become negligible, but it is stated that **10 ft. spheres** have been used for the purpose, apparently with satisfactory accuracy.

One is reminded of the old question, how far can **deficiency in daylight factor** be compensated by **light walls and ceilings,** by some recent correspondence in the I.E.S. *Lighting Review* (Australia), where an architect (Mr. Alec S. Hall) refutes the suggestion that any material improvement can be secured by a special sloping ceiling. He points out that the remote parts of such a ceiling could only receive any light from near the horizon, which is most liable to be obstructed by buildings, etc., and concludes that the only really useful light is that derived directly from the sky.

Although I believe personally that light coloured walls and ceilings are very desirable, not only psychologically but also physically, I myself now accept the view that only a small improvement in the daylight factor can thus be secured. This is the crucial consideration. Though, with very bright daylight, an apparent absolute gain in foot-candles at the remote end of the room may be demonstrated, this become negligible on the darkest days. Far better **correct the deficiency** by **supplementary artificial lighting.**

I.E.S. Fellowship

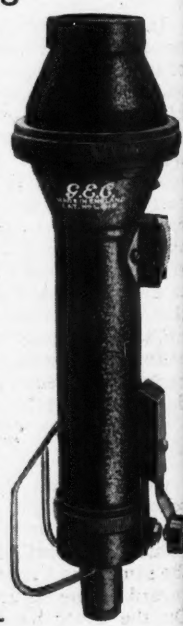
In view of the fact that no copy of the I.E.S. "Transactions" is being issued this month, we have been asked to mention the names of those recently admitted to fellowship of the Illuminating Engineering Society, which are as follows:—

Professor T. David Jones (Cardiff).
Mr. D. L. Tabraham (Bristol).
Mr. E. M. Thompson (Wigan).
Major D. Wilman (London).
Mr. N. G. Wilson (Edinburgh).

As a matter of interest we give in each case the town of residence. It will be noted that the successful candidates are very widely distributed, each one hailing from a different area.

We are also asked to state that the usual additions to the List of Members will appear in the next (December) issue of the " Transactions."

A New Marine Signalling Torch



We show here a new torch (G.E.C.) approved by the Admiralty for night signalling and designed to meet the needs of shipowners and stores merchants for a robust article. This torch has an overall length of 11 in., and takes an Osram 2 v. 0.3 amp. lamp. It can be worked by two L.6103 unit cells, is fitted with a Morse tapper key and thumb switch and a carrying handle (which may also serve as a stand) and a spare bulb holder.

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